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~~Mechanical Bending Device and Mechanical Arrangement~~

~~with this Type of Bending Device~~

MECHANICAL BENDING APPARATUS

BACKGROUND OF THE INVENTION

The invention concerns a mechanical bending ~~device~~apparatus for bending flat workpieces, especially sheet metal, with at least one bending tool~~,~~ assembly which has at least one part that can be moved by means of a drive, whereby the workpiece can be bent along a bending line when acted on by the moving tool part, and the moveable tool part ~~contains~~is comprised of adjacent segments~~, one after another,~~ in the direction of the bending line. ~~The invention also concerns a mechanical arrangement with the bending device described above.~~

The generic state of the art is ~~document~~illustrated and described in DE 196 40 124 A1. This prior publication discloses a bending machine with a ~~swivel~~swiveling bending tool. A bending cheek of the ~~swivel~~swiveling bending tool is provided with a

bending cheek tool, which is in turn composed of tool ~~sections~~segments arranged in a row in the direction of the bending line. Individual tool ~~sections~~segments can be moved back and forth between ~~the~~ "on" and "off" positions. If the tool ~~sections~~segments are in the "on" position, they act on the workpiece when the bending ~~cheeks~~cheek segments swivel and thus help bend it. When they go into the "off" position, the tool ~~sections~~segments pass by the workpiece without deforming it. ~~For tooling, the~~The bending cheek is always ~~swiveled~~swiveling with all tool ~~sections~~segments, i.e., those in both the "on" and "off" positions.

~~This invention is designed to advance the state of the art by making improved adjustment to changing applications possible.~~

~~The invention solves the problem with the mechanical bending device in Patent Claim 1 and the mechanical arrangement in Patent Claim 10.~~

It is an object of the present invention to provide a novel bending tool assembly which is rapidly adjustable for changing the effective length of the bend to be produced.

It is also an object to provide such an assembly which is readily fabricated and easily operated.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects may be readily attained in a mechanical bending apparatus for bending flat workpieces (6) including at least one bending tool assembly (9, 9a) which has at least one tool part that can be moved by means of a bending tool drive (27, 27a) to bend the workpiece along a bending line (11) by being acted on by the movable tool part. The movable tool part is

comprised of a multiplicity of adjacent segments disposed along the direction of the bending line (11), and each operatively connectable to the bending tool drive (27, 27A) to permit ready variation of the number of segments so connected and thereby the operative length of the movable tool part.

The bending tool (9, 9a) is a swivelable bending tool with a movable tool part in the form of a bending cheek (14, 14a) that can swivel on a swivel axis (21) running in the direction of the bending line (11). The bending cheek (14, 14a) is comprised of a multiplicity of segments (17, 17a), at least some of which can be selectively connected to the bending tool drive (27, 27a) and can be swiveled on the swivel axis (21) when the drive connection is made to produce the bending action on the workpiece. At least some segments (17, 17a) of the bending cheek (14, 14a) are two-arm swivelable levers with a bending arm (19, 19a) provided on one side of the swivel axis (21) for acting on the workpiece and bending it. A drive arm (20, 20a) is provided on the other side of the swivel axis (21) for selective connection to the bending tool drive (27, 27a).

Preferably, at least one swivelable lever can be engaged by a switching device (34) on the drive arm side in a recess (35) on a driver (36) of the bending drive (27a) or disengaged from that recess (35) whereby the connection between the swivelable lever and the bending drive (27a) is made in the engaged mode and is broken in the disengaged mode.

The tool assembly includes a control element (24) with a track (23) between at least some of the swivelable levers and the bending drive (27) and some swivelable levers are supported on the drive arm side on the track (23) of the control element (24).

The swivelable levers being selectively connected to the bending tool drive on the bending tool drive side by a switching device. When the drive connection is made between the control element (24) and the bending tool drive (27), the swivelable lever is acted on by the track (23) of the control element (24) on the drive arm side and can thereby swivel about the swivel axis (21) to produce the bending action on the workpiece. The switching device for selectively connecting the control element (24) and the bending tool drive (27) has at least one coupling part (25) that can be selectively engaged and disengaged between the control element (24) and the bending tool drive (27). The connection between the control element (24) and the bending tool drive (27) is made when the coupling part (25) is engaged and broken with the coupling part (25) is disengaged.

As indicated, the bending tool assembly (9, 9a) is swivelable and includes a hold-down device (15) extending along the bending line (11) so that the workpiece can be acted upon in its transverse direction and can thereby be fixed between the hold-down device (15) and a workpiece support (16) on the side of the workpiece opposite the hold-down device (15). The hold-down device (15) is comprised of a multiplicity of adjacent segments (18) disposed along the direction of the bending line (11), and at least some of the segment can be selectively connected to a drive for the hold-down device (15). These segments can be moved into a position where they act on the workpiece by producing a drive connection to bend the workpiece with the segments (18) of the hold-down device (15) and segments (17, 17a) of the bending cheek (14, 14a) working together at the same time when the drive of the hold-down device (15) or

the bending tool drive (27, 27a) are connected thereto. At least two swivelable bending tool assemblies (9) can be utilized, each of which has a bending cheek (14) that can swivel, with at least some segments (17) of the bending cheek (14) being selectively connectable to the bending tool drive (27) and a hold-down device (15). The bending cheek (14) of one bending tool assembly and the hold-down device (15) of the other bending tool assembly (9) are arranged on the same side of the workpiece. On one side of the workpiece (6), the hold-down device (15) has a drive (30), and the bending tool drive (27) of the hold-down device (15) of the other bending tool assembly (9) have at least one common drive element.

The bending apparatus can be included in a machine tool for bending panels on a flat workpieces (6) which includes at least one mechanical cutting device (39) for machine cutting bendable panels in the workpiece, and at least one bending tool assembly (9, 9a) as described hereinbefore so that a control device for the machine can move the workpiece bet3ween a cutting station and a bending station.

~~In the case of the invention, at least one segment of the tool part is used which can be~~ In the present invention, one or more segments of the tool parts which are used are connected ~~optionally~~ to the bending tool drive. When the workpiece is being formed, the only segments of the tool part that are moved are those that are actually needed to produce the desired bend. The other segments of the tool part can stay in the resting or "off" position. The right bending tool assembly is therefore available for each bending cycle and no tool change has is necessary.

~~Special embodiments of the invention are described in dependent patent claims 2 to 9. In the design of the invention in Patent Claim 2, the bending tool swivels and has cheek segments that can be driven, if necessary.~~ The advantage of using the swiveling bending tool in the invention is that only the ~~curved workpiece~~operative bending arm leaves its starting position when the workpiece is being tooled. The rest of the workpiece can stay in its initial position during the tooling process, unlike press braking, for example.

~~In the interest of an effective, easy to build means of introducing the bending force needed for tooling the workpiece, the bending device in Claim 3 of the invention is built with at least one segment of the bending cheek as a two arm swiveling lever with a bending arm and a drive arm.~~

~~The designs in Patent Claims 4 to 6 of the invention provide structurally easy to change ways of optionally making or breaking the drive connection between the movable segments of the tool part of the bending tool and the bending drive.~~
~~In another advantageous embodiment of the invention, according to Patent Claim 7, not only is the part of the tool that can move when the workpiece is being formed divided into segments, but so is the holding down device assigned to that tool part. The segments of the holding down device can optionally be~~ By having the hold-down divided into segments, those segments can be selectively connected to the drive of the ~~holding down device. A connection with the accompanying drive is made for those segments of the holding down device and~~hold-down device. The drive for the bending cheeks ~~that work~~works together with the drive for the hold-down device when a workpiece is being tooled. Accordingly, the workpiece is acted ~~on~~upon by the

~~holding~~hold-down device or segments of the ~~holding~~hold-down device only in the area where the desired bend is to be made. Segments of the ~~holding~~hold-down device arranged in other, roughly adjacent areas of the workpiece can be kept away from the workpiece. This ~~possibility~~ is a special advantage if a bend must be made close to a bend that already exists on the workpiece. If the action of the workpiece with the segments of the ~~holding~~hold-down device is limited to the area of the workpiece with the additional bend, then unwanted deformation of the already existing bend is prevented by the segments of the holding-down device.

~~The model of the invention in Patent Claim 8 has the option of making~~ By providing two bending tool assemblies on the machine, the operator can make bends in opposite directions on the workpiece ~~being tooled~~. In the interest of a compact, inexpensive design, ~~Patent Claim 9 provides that~~ the drive of one bending assembly tool and the drive of the ~~holding~~hold-down device of the other bending tool assembly have at least one drive element in common, on at least on one side of the workpiece ~~being tooled~~.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The present invention will be explained in greater detail below with ~~examples and highly schematic~~the drawings. illustrating embodiments of the invention wherein:

Figure 1 ~~shows~~schematically illustrates a bending machine for machine- bending a ~~piece~~workpiece of sheet metal;

Figures 2 to 6 ~~show~~ are enlarged illustrations of the bending tool assembly at various points in the sequence of a bending cycle ~~using the~~ operating ~~states produced~~

~~thereby~~ for a bending tool assembly that can be used on the ~~first type of~~ bending machine in Figure ~~1.~~1;

Figures 7a to 7d and 8a to 8d show ~~how~~the operation of the second type of bending tool ~~works~~which may be used on the bending machine in Figure ~~1,~~1;

Figure 9 shows a double tool assembly that can be used on the bending machine in Figure 1 ~~and~~;

Figure 10 shows a mechanical arrangement for machining sheet metal with a separate bending and ~~a cutting station.~~cutting stations; and

Figures 11a-11d diagrammatically illustrate the operation of the tool components in the embodiment of Figures 2-6.

DETAILED DESCRIIPTION OF THE ILLUSTRATED EMBODIMENTS

According to Figure 1, a bending machine 1 has a C-shaped frame generally designated by the numeral 2 with a top arm 3 and a bottom arm 4. A conventional coordinate guide ~~5 is placed in the space on~~assembly generally designated by the numeral 5 is located in the throat of the bending machine 1 between the top arm 3 and the bottom arm 4 of the frame~~.~~ 2. A workpiece 6 to be machined in the form of a piece of sheet metal ~~6~~ is held ~~on~~in the coordinate guide 5 by means of ~~clips,~~ clamps (not shown), and can move with the corresponding movement of the coordinate guide assembly 5 in the horizontal plane of the sheet metal~~.~~ workpiece 6. When it is moved by the coordinate guide assembly 5, the sheet metal workpiece 6 rests on a workpiece support table 7 of the usual kind placed on top of the bottom arm 4.

The purpose of moving the sheet metal 6 with the coordinate guide assembly 5 is to position it opposite a mechanical bending device in ~~the form of~~ a bending station 8 on the free end of the top arm 3. At the bending station 8, ~~folds~~bends 10 of different lengths are made along the bending lines 11 with a bending tool ~~9. Folded grooves 12 were~~generally designated by the numeral 9. The workpiece 6 has been previously processed to produce a series of panels 12 which are cut free on three sides of the flat sheet metal workpiece ~~6 in the tooling cycle~~ before the sheet metal workpiece 6 is bent. ~~Grooves~~Panels 13 still lying in the plane of the sheet metal 6 are also shown in Figure 1. The folding of one of these ~~grooves~~panels 13 along a bending line 11 will be described below.

Figures 2 to 6 show the bending tool 9 as a swiveling bending tool with a bending cheek 14, a ~~holding~~hold-down device 15 and a workpiece support 16. The bending cheek 14 is composed of five segments ~~of bending cheeks~~ 17, and the ~~holding~~hold-down device 15 is composed of five segments ~~of holding-down device~~ 18. Both the segments 17 of the bending ~~cheeks 17~~cheek 14 and the segments 18 of the ~~holding-down device 18 are lined up~~hold-down device 15 are aligned in a row in the direction of the bending line 11 ~~defined by~~of the bending cheek 14 ~~and~~ work with ~~holding~~those of the hold-down device 15.

The segments 17 of the bending ~~cheeks 17~~cheek 14 are designed as swiveling levers, and each has a bending arm 19 and a drive arm 20. They are mounted so they can swivel on a swivel axis 21 on a bending cheek holder 22 ~~of~~at bending station 8. The drive arms 20 are supported with their free ends on a control path ~~23~~,23 which is provided ~~in turn~~ on ~~a~~ the control element 24. The control elements 24 can move in a straight line ~~on~~relative to the bending cheek holder 22. The control elements 24 can be connected to the piston ~~25~~26 of a bending drive 27 ~~via~~by couplings 25. An individual coupling 25 is assigned to each control element 24. The couplings 25 can be engaged or disengaged by means of regulating devices~~,~~ (not shown), individually between the control elements 24 and the piston 26 of the bending drive 27.

Alternately, the control elements 24 and the piston 26 of the bending drive 27 can also be coupled ~~with~~by a coupling that can be moved in the direction of the swivel axis 21 between the control elements 24 and the piston 26 and whose length is dimensioned ~~in such a way~~so that it can be arranged between one or more, or

maximally all, control elements~~,~~ 24 on one hand ~~24,~~, and the piston ~~26,~~26 on the other hand.

It is also ~~conceivable~~possible to provide a shaft-like component for coupling the control elements 24 and the piston ~~26 whose~~26. The shaft has an axial direction which runs parallel to the swivel axis 21 and which has shaft sections one after another in that direction that are assigned to different control elements 24 and in the circumferential direction of the shaft, radial projections staggered relative to one another, whereby, depending on the rotational setting of the shaft to its axis, a different number of shaft sections is effective, and so a different number of control elements 24 is connected to the piston 26 by the radial shaft projections to control the number of segments 17 which are simultaneously actuated.

The ~~ratios on~~factors for the ~~holding~~hold-down device 15 are like those on the bending cheek 14. A coupling ~~part~~ 28 is assigned to each segment 18 of the ~~holding~~hold-down device ~~18.~~15. By means of a setting device~~, also~~ (not shown), the couplings 28 can be engaged or disengaged individually between the segments 18 of the ~~holding~~hold-down device ~~18~~15 and the piston 29 of the drive 30 of ~~a holding~~the hold-down device ~~30.~~15. The segments 18 of the ~~holding~~hold-down device ~~18~~15 can move linearly in the direction of movement of the piston 29 on a ~~holding~~hold-down device carrier 31. Corresponding to couplings 25, couplings 28 can be replaced by structurally different components to produce a drive connection between the piston 29 of the drive ~~of the holding down device~~ 30 of the hold-down device 15 and the segments 18 of the ~~holding~~hold-down device ~~18.~~15.

The initial situation before the sheet metal ~~6 starts being machine~~ workpiece 6 is bent ~~is~~as shown in ~~Figure 2.~~Figures 2 and 11a. The sheet metal workpiece 6 shown in dashes ~~6~~in Figure 2 lies on the workpiece support 16. The bending ~~cheeks~~cheek 14 and the selected bending cheek segments 17 are in their starting position. The ~~holding~~hold-down device 15 and the segments 18 of the ~~holding~~hold-down device ~~18~~15 are ~~pulled back off~~positioned away from the sheet metal workpiece 6. The couplings 25, 28 are engaged. There is therefore no drive connection between the segments 17 of the bending ~~cheeks 17~~cheek 14 and the bending drive 27 and no drive connection between the segments ~~of the holding down device~~ 18 of the hold-down device 15 and the drive 30 of the ~~holding~~hold-down device ~~30.~~15.

To prepare for the bending process, a number of couplings 25, 28 consistent with the length of the ~~fold being~~bend to be made is engaged between the piston 26 of the bending drive 27 and the control elements ~~24 or~~24, and between the segments ~~of the holding down device~~ 18 of the hold-down device 15 and the piston 29 of the drive 30 of the ~~holding~~hold-down device ~~30.~~15.

In the example shown, two couplings 25, 28 are taken from their "off" position in Figure 2 into their "on" position in Figure 3.

Now, if the piston 26 of the bending drive 27 and the piston 29 of the drive of the ~~holding~~hold-down device ~~30~~15 are ~~pushed~~moved in the direction of arrows 32, 33, the two couplings 25 engaged come to ~~lie~~bear on the two assigned control elements 24 and the two couplings 28 engaged come to lie on the two accompanying segments 18 of the ~~holding~~hold-down device ~~18~~.15. Thus, the two segments 18 of the ~~holding~~hold-down device ~~18~~15 are connected to the drive 30 of the ~~holding~~hold-down device ~~30~~,15, and the two control elements 24 and with them the two accompanying segments 17 of the bending ~~cheeks 17~~cheek 14 are connected to the bending drive 27. The operating mode is shown in Figure ~~4 exists.~~4.

Starting from these conditions, if the drive 30 of the ~~holding~~hold-down device ~~30~~ 15 is activated, the segments 18 of the ~~holding-down device 18~~hold-down device 15 previously activated, i.e., connected to the drive 30 of the ~~holding~~hold-down device ~~30~~15 drop down onto the sheet metal workpiece 6. As a result of the positioning of the sheet metal workpiece 6 in ~~relation to~~ the bending station 8, the activated segments 18 of the ~~holding~~hold-down device ~~18~~15 with their projecting ends come to lie in that area of the sheet metal workpiece 6 in which the flat ~~groove~~panel 13 to be folded connects to the remaining sheet metal ~~6 (~~workpiece 6 as seen in Figure ~~5).~~5. Because of the compressive pressure applied by the drive 30 of the ~~holding~~hold-down device ~~30~~,15, the sheet metal workpiece 6 is secured against any movement between the working segments 18 of the ~~holding~~hold-down device ~~18~~15 and the workpiece support ~~16 against any movement.~~16.

Now, if the piston 26 of the bending drive 27 leaves its position shown in Figures 4,4 and 5 and moves in the direction of arrow 32, the two activated control elements 24 are moved up on the figuresupwardly as seen in Figu8res 5 and 11b-11d. The accompanying segments 17 of the bending cheeks 17cheek 14 with their drive arms 20 thus slide along the tracks 23 of the two control elements 24. The two activated segments 17 of the bending cheeks 17cheek 14 consequently swivel on the swivel axis 21 and their bending arms 19 bend the groovepanel 13 of the sheet metal 6 upward,workpiece 6 upwardly as shown in Figure 6 with their bending arms 19.Figures 6 and 11b-d. Thus, the desired foldbend is made, and the bending tool 9 can be sent backreturned to its initial position in Figure 2 by a return stroke of the pistons 26, 29 and corresponding return movementsmovement of the bending cheek elementssegments 17 and segments 18 of the holdinghold-down device 1815 used for toolingforming the sheet metal workpiece. 6.

A The bending tool 9a shown in Figures 7a to 7d and 8a to 8d differs from the bending tool 9 in Figures 2 to 6 basically in terms of the activation and operation of the bending cheek 14a. Thus, to activate and deactivate the swivel- lever-type segments 17a of the bending cheeks 17acheek, a switching device 34 in the form of a regulating piston/cylinder is used. Thus each segment 17a of the bending cheeks 17cheek 14a has its own regulating device 34 assigned to it.

Segments 17a of the bending cheeks 17cheek 14a that are to be used in the subsequent machine toolingoperation are pushed into a receptaclerecess 35 on a driver 36 of a bending drive 27a by the switching device 34 on one drive arm 20a. If the

driver 36 is then pushed out of its starting position shown in Figure 7a into its end position in Figure 7d, it takesmoves the drive arm 20a or the bending cheek segment or segments 17a with it. As a result, the segments 17a of the bending cheeks 17a in question14a swivel on their swivel axis 21 and deform the sheet metal 6workpiece 6 to the desired extent by means of athe bending arm 19a in the way desired. Segments 17a of the bending cheeks 17cheek 14a that are not used when the sheet metal workpiece 6 is tooledbent are pushed out of the receptaclerecess 35 on the driver 36 of the bending drive 27a by the respective switching device 34 or kept in the disengaged position. As shown in Figures 8a to 8d, the driver 36 is then pushed horizontally without the disengaged segments of the bending cheeks 17cheek 14a swiveling on the axis 21 orto deform the sheet metal 6 being deformed.workpiece 6.

A double tool 37 shown in Figure 9 and includes two bending toolstool assemblies 9 that correspond to one another in design and function and are arrangeddisposed 180° from one another. On one and the same side of the sheet of metal 6 being machined therefore are a holdinghold-down device 15 of the one bending tool assembly 9 and a bending cheek 14 of the other bending tool assembly 9. Because of this design, folds can be made in opposite directions on the bending toolstool assemblies 9. A grooveThe panel of the sheet metal workpiece 6 folded under is shown in Figure 9.

Couplings 25, 28 can be used on both sides of the sheet metal workpiece 6 optionally to activate a bending cheek 14 or to activate a ~~holding~~hold-down device 15. Depending on which bending tool part is activated, a hydraulic drive works as a bending drive 27 with piston 26 or as the drive of a ~~holding~~hold-down device ~~30~~15 with piston 29.

In Figure 10, the bending station 8 is integrated into a ~~mechanical arrangement~~machine tool 38 for ~~machining~~processing a sheet metal ~~6 that~~workpiece 6 and it also includes a mechanical cutting device 39 for machine- cutting the sheet metal workpiece 6. The cutting device 39 is a punch in the example shown. Other conceivable examples are water, ~~a~~ plasma and/or laser-cutting devices. With the cutting device 39, first the grooves on three sides are cut free to provide the panels on the flat sheet metal workpiece 6. Then, the sheet metal workpiece 6 is positioned ~~with~~by the coordinate guide 5 ~~opposite~~in the bending station 8 ~~in such a way~~so that the flat ~~grooves~~panels can be ~~folded~~bent as shown ~~by the bending station 8.~~.

The machine functions are CNC-controlled on all the machine-tooling devices described above.

~~Patent Claims~~

Thus, it can be seen from the foregoing detailed description and attached drawings that the bending tool assembly of the present invention can be readily adjusted for bending different lengths of the workpiece and that the components can be readily fabricated and assembled

CLAIMS

Having thus described the invention, what is claimed is:

1. A mechanical bending ~~device~~apparatus for bending flat workpieces~~, especially sheet metal~~ (6)~~, with~~ including at least one bending tool assembly (9, 9a)~~,~~ which has at least one tool part that can be moved by means of a bending tool drive (27, 27a)~~, wherein~~ to bend the workpiece ~~can be bent~~ along a bending line (11) by being acted on by the ~~part of the~~movable tool ~~that moves, and the movable part of the tool includes segments of the tool parts one after another in~~part, said movable tool part comprising a multiplicity of adjacent segments disposed along the direction of the bending line (11), ~~characterized by the fact that at least one segment of the tool part can be connected optionally~~and each operatively connectable to the bending drive (27, 27a~~)~~A) to permit ready variation of the number of segments so connected and thereby the operative length of the movable tool part.

2. The mechanical bending ~~device in Claim 1, characterized by the fact that a swiveling bending tool is provided as~~apparatus in accordance with Claim 1 wherein the bending tool (9, 9a) is a swivelable bending tool with a movable tool part in the form of a bending ~~cheeks~~cheek (14, 14a) that can swivel on a swivel axis (21) running in the direction of the bending line (11)~~,~~ and ~~by the fact that~~wherein the bending ~~cheeks~~cheek (14, 14a) ~~contain segment of the tool parts in the form~~is comprised of a multiplicity of segments ~~of the bending cheeks~~ (17, 17a), at least ~~one~~some of which can be ~~optionally~~selectively connected to the bending tool drive (27, 27a) and can be

swiveled on the swivel axis (21) when the drive connection is made~~, and there is~~ to produce the bending action on the workpiece.

3. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that at least one segment of the bending cheeks (17, 17a) is designed as a~~apparatus in accordance with Claim 2 wherein at least some segments (17, 17a) of the bending cheek (14, 14a) are two-arm ~~swiveling levers~~swivelable levers with a bending arm (19, 19a) provided on one side of the swivel axis (21) for acting on the workpiece and bending it, and with a drive arm (20, 20a) provided on the other side of the swivel axis (21)~~, for optionally connecting the drive~~ for selective connection to the bending tool drive (27, 27a).

4. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that~~apparatus in accordance with Claim 3 wherein at least one ~~swivel~~swivelable lever can be engaged by ~~means of~~ a switching device (34) on the drive arm side in a ~~receptacle~~recess (35) on a driver (36) of the bending drive (27a) or disengaged from that ~~receptacle~~recess (35), whereby the connection between the ~~swivel~~swivelable lever and the bending drive (27a) is made in the engaged mode and is broken in the disengaged mode.

5. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that it has~~apparatus in accordance with Claim 3 wherein there is included a control element (24) with a track (23) between at least ~~one swivel lever~~some of said swivelable levers and the bending drive (27)~~, whereby the swivel lever is~~ and some swivelable levers are supported on the drive arm side on the track (23) of the control ~~(24), and it can be~~element (24), said swivelable levers being selectively connected ~~optionally~~ to the bending drive on the bending tool drive side by ~~means of~~ a switching device, whereby, when the drive connection is made between the control element (24) and the bending tool drive (27), the ~~swivel~~swivelable lever is acted on by the track (23) of the control element (24~~) via its track (23~~) on the drive arm side and can thereby swivel ~~on~~about the swivel axis (21) ~~when there is~~to produce the bending action on the workpiece.

6. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that~~apparatus in accordance with Claim 5 wherein the switching device for ~~optionally~~selectively connecting the control element (24) and the bending tool drive (27) has at least one coupling part (25) that can be selectively engaged ~~or~~and disengaged between the control element (24) and the bending tool drive (27), whereby the connection between the control element (24) and the bending tool drive (27) is made ~~with~~when the coupling part (25) is engaged and broken with the coupling part (25) is disengaged.

7. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that~~apparatus in accordance with Claim 1 wherein the bending tool assembly (9, 9a)~~, designed as a swiveling bending tool, has a holding~~ is swivelable and includes a hold-down device (15) extending along the bending line (11), ~~by means of which~~so that the workpiece can be acted ~~on~~upon in ~~the~~its transverse direction ~~of its flat extension~~ and can thereby be fixed between the ~~holding~~hold-down device (15) and a workpiece support (16) on the side of the workpiece opposite the ~~holding~~hold-down device (15), ~~and by the fact that the holding~~said hold-down device (15) ~~includes~~being comprised of a multiplicity of adjacent segments ~~of the holding-down device (18) one after another in~~(18) disposed along the direction of the bending line (11), at least ~~one~~some of which can ~~optionally~~ be selectively connected to a drive ~~of~~for the ~~holding~~hold-down device (~~30~~15) and can be ~~transferred~~moved into a position where ~~it acts~~they act on the workpiece by producing a drive connection~~, whereby when~~ to bend the workpiece ~~is bent, segments of the holding~~with the segments (18) of the hold-down device (~~18~~15) and segments ~~of the bending cheeks~~ (17, 17a) of the bending cheek (14, 14a) working together at the same time ~~with~~when the drive of the ~~holding~~hold-down device (~~30~~15) or ~~with~~ the bending tool drive (27, 27a) are connected thereto.

8. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that~~apparatus in accordance with Claim 1 wherein there are at least two swivelable bending ~~tools (9) are provided in the form of swivel bending~~

~~tools~~tool assemblies (9), each of which has a bending cheek (14) that can swivel, with at least ~~one segment of the bending cheeks (17) that can be connected optionally~~some segments (17) of the bending cheek (14) being selectively connectable to the bending tool drive (27) and a ~~holding~~hold-down device (15), whereby the bending cheek (14) of one bending tool assembly and the ~~holding~~hold-down device (15) of the other bending tool assembly (9) are arranged on ~~one and~~ the same side of the workpiece.

9. The mechanical bending ~~device in one of the preceding claims, characterized by the fact that~~assembly in accordance with Claim 8 wherein on at least on one side of the workpiece (6), the ~~holding~~hold-down device (15) has a drive (30), and the bending tool drive (27) of the ~~one and the drive of the holding~~hold-down device (~~30~~15) of the other bending tool assembly (9) have at least one common drive element.

~~10. A mechanical arrangement for machining~~ 10. A machine tool for bending panels on a flat workpieces~~, especially sheet metal (6), characterized by the fact that at least one mechanical bending device (8) according to one of Claims 1 to 9 and also~~ (6), including:

(a) at least one mechanical cutting device (39) for machine~~-cutting workpieces are provided, whereby workpiece parts can be bent and machine-cut by means of the mechanical cutting device (39).~~ cutting bendable panels in the workpiece; and

~~Abstract~~

(b) at least one bending tool assembly (9, 9a) including at least one tool part that can be moved by means of a bending tool drive (27, 27a), to bend the workpiece along a bending line (11) by being acted on by the movable tool part, said movable tool part comprising a multiplicity of adjacent segments disposed a along the direction of the bending line (11), and each operatively connectable to the bending drive (27, 27A) to permit ready variation of the number of segments so connected and thereby the operative length of the movable tool part.

11. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 10 wherein the bending tool (9, 9a) is a swivelable bending tool with a movable tool part in the form of a bending cheek (14, 14a) that can swivel on a swivel axis (21) running in the direction of the bending line (11), and wherein the bending cheek (14, 14a) is comprised of a multiplicity of segments (17, 17a), at least some of which can be selectively connected to the bending tool drive (27, 27a) and can be swiveled on the swivel axis (21) when the drive connection is made to produce the bending action on the workpiece.

12. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 11 wherein at least some segments (17, 17a) of the bending cheek (14, 14a) are two-arm swivelable levers with a bending arm (19, 19a) provided on one side of the swivel axis (21) for acting on the workpiece and bending it, and with a drive arm (20, 20a) provided on the other side of the swivel axis (21) for selective connection to the bending tool drive (27, 27a).

13. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 12 wherein at least one swivelable lever can be engaged by a switching device (34) on the drive arm side in a recess (35) on a driver (36) of the bending drive (27a) or disengaged from that recess (35), whereby the connection between the swivelable lever and the bending drive (27a) is made in the engaged mode and is broken in the disengaged mode.

14. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 12 wherein there is included a control element (24) with a track (23) between at least some of said swivelable levers and the bending drive (27) and some swivelable levers are supported on the drive arm side on the track (23) of the control element (24), said swivelable levers being selectively connected to the bending drive on the bending tool drive side by a switching device, whereby, when the drive connection is made between the control element (24) and the bending tool drive (27), the swivelable lever is acted on by the track (23) of the control element (24) on the drive arm side and can thereby swivel about the swivel axis (21) to produce the bending action on the workpiece.

15. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 14 wherein the switching device for selectively connecting the control element (24) and the bending tool drive (27) has at least one coupling part (25) that can be selectively engaged and disengaged between the control element (24) and the bending tool drive (27), whereby the connection between the control element (24) and the bending tool drive (27) is made when the coupling part (25) is engaged and broken with the coupling part (25) is disengaged.

16. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 10 wherein the bending tool assembly (9, 9a) is swivelable and includes a hold-down device (15) extending along the bending line (11), so that the workpiece can be acted upon in its transverse direction and can thereby be fixed between the hold-down device (15) and a workpiece support (16) on the side of the workpiece opposite the hold-down device (15), said hold-down device (15) being comprised of a multiplicity of adjacent segments (18) disposed along the direction of the bending line (11), at least some of which can be selectively connected to a drive for the hold-down device (15) and can be moved into a position where they act on the workpiece by producing a drive connection to bend the workpiece with the segments (18) of the hold-down device (15) and segments (17, 17a) of the bending cheek (14, 14a) working together at the same time when the drive of the hold-down device (15) or the bending tool drive (27, 27a) are connected thereto.

17. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 10 wherein there are at least two swivelable bending tool assemblies (9), each of which has a bending cheek (14) that can swivel, with at least some segments (17) of the bending cheek (14) being selectively connectable to the bending tool drive (27) and a hold-down device (15), whereby the bending cheek (14) of one bending tool assembly and the hold-down device (15) of the other bending tool assembly (9) are arranged on the same side of the workpiece.

~~A mechanical bending device and a mechanical arrangement with this type of bending device.~~

18. A machine tool for bending panels on a flat workpieces (6) in accordance with Claim 17 wherein on at least on one side of the workpiece (6), the hold-down device (15) has a drive (30), and the bending tool drive (27) of the hold-down device (15) of the other bending tool assembly (9) have at least one common drive element.

ABSTRACT

A mechanical bending device (8) for bending flat workpieces~~, especially sheet metal~~ (6)~~,~~ has at least one bending tool assembly (9)~~,~~ which includes at least one tool part that can move by means of a bending tool drive (27). When acted on by the tool part that moves, the workpiece can be bent along a bending line (11). The movable tool part ~~has~~is comprised of a multiplicity of adjacent segments ~~of the tool parts one after another~~disposed in the direction of the bending line (11), ~~at least one of~~ which segments can be selectively connected ~~optionally to the bending drive (27). A mechanical arrangement for machining flat workpieces, especially sheet metal (6) includes, besides the mechanical bending device (8) described, a mechanical cutting device. On~~to the bending tool drive (27) to provide the desired operational length for the bending tool assembly. The machine tool incorporating the mechanical bending device ~~(8),~~can also include a mechanical cutting device so that workpiece parts can be both bent and machine~~-cut by means of the mechanical cutting device.~~ cut in the same machine tool.

~~(Figure 2)~~